HINTS ON HEATING, HARDENING, AND TEMPERING STEEL,

AND OTHER USEFUL INFORMATION CONNECTED THEREWITH;

ALSO,

BARROWMAN'S VALUABLE TABLE ON TEMPERING STEEL,

AND

Extracts from the Works of KIRKALDY, STYFLE, *and* SIR WILLIAM FAIRBAIRN, *on the Various Properties of Steel.*

BY ALBERT JOWITT, ESQ.
SHEFFIELD.

TO WHICH IS ADDED

FROTHINGHAM & WORKMAN'S

CIRCULAR

OF

THOMAS JOWITT & SON'S

CAST, SPRING, MACHINERY, AGRICULTURAL

AND OTHER

STEELS.

Warehouse and Offices, 395 to 399 and 405, St. Paul Street,

MONTREAL.

HINTS ON HEATING, HARDENING AND TEMPERING STEEL,

AND OTHER USEFUL INFORMATION CONNECTED THEREWITH;

ALSO,

BARROWMAN'S INTERESTING AND VALUABLE TABLE ON TEMPERING STEEL;

And Extracts from the Works of KIRKALDY, STYFLE, *and* SIR WILLIAM FAIRBAIRN, *on the Various Properties of Steel.*

BY ALBERT JOWITT, ESQ.

OF all metals, cast steel is the most puzzling to the buyer, from the fact that the outside appearance of the bars gives not the slightest clue to the quality; it is impossible to form the least idea of its value, or use, or temper, from its outside appearance.

The present high prices of Swedish and Russian irons, from which all best cast steel is made, and the unprecedented rise in coal, coke, &c., have induced many houses to try cheaper irons from which to make best cast steel, but without any permanent success — and only proving "that there is nothing so dear as cheap cast steel.

The temper of steel is of as much importance as the quality. The fractured end of a bar of cast steel will, to an experienced eye, give a fair idea of its temper — if the grain appears rough or coarse, it is mild; if close and smooth, it indicates hardness.

In ordering steel, the purpose for which it is required should always be given.

In ordering large sizes, the shape, breadth, and thickness — and, to save waste, the length of each bar should be given.

Some men have the ability and prefer to work steel of a hard temper, whilst others cannot even heat hard steel without spoiling it; this should be kept in mind when ordering.

Cast steel for turning tools is of a hard temper, and should never be heated beyond a bright red.

Welding cast steel, double shear steel, blister steel, German steel, &c., are made mild in temper, and will stand a smart heat.

Steel that is weathered, by standing in the open air, will work better than steel fresh from the manufacturers.

Steel that has been rejected by the smith as too hard and fiery, has, after acquiring a coating of rust, from exposure to the weather, been found to answer the purpose for which it was formerly rejected.

The process of hardening is by far the most difficult part of the steel-worker's trade. Before a tool can be hardened properly, the quality, as well as the temper of the steel used, should be known; if the steel is mild a higher heat is necessary than if hard. If the steel is cheap, made from common irons, the liability to crack is great; or if the water is too cold and thin, the same thing may be expected.

The density of the hardening water is a most important consideration; common salt is the best medium for thickening hardening water. In cold weather it should have the chill taken off. Large cast steel tools, dipped in cold, thin water, are sure to crack — as many tools break by lifting them out of the water before they are cold. Heating a tool all over, and only partly dipping it into water, will cause it to crack. Chipping chisels often break from being only partly dipped, instead of being entirely immersed. When hardening bright tools, it is best to coat them with some substance to prevent the water acting too suddenly.

From Barrowman's Treatise on the Metallurgy of Iron.

Page 379.

The process of tempering consists in reheating hardened steel to a temperature varying with the degree of hardness required, and cooling it by immersion in the same manner. The proper temperature is indicated by the colour of the thin film of oxide formed on the surface of the heated steel, according to the following scale: —

Temperature.	*Colour.*	*Proper Temper for*
220°	Pale yellow	Lancets.
230	Straw yellow	Razors and surgical instruments.
243	Golden yellow	Common razors and pen-knives.
255	Brown	Cold chisels, shears, scissors.
265	Brown, dappled with purple	Axes, planes, &c.
277	Purple	Table knives, large shears.
288	Bright blue	Swords, coiled springs.
293	Full blue	Fine saws, augers, &c.
316	Dark blue	Hand and pit saws.

EXTRACTS *from Results of an Experimental Enquiry into the Comparative Tensile Strength and other Properties of the Various Kinds of Wrought Iron and Steel.* BY DAVID KIRKALDY: Glasgow.

"Some descriptions of steel are found to be very hard, and, consequently, suitable for some purposes, whilst others are extremely soft, and equally suitable for other uses."—*Page* 92.

"Steel invariably presents, when fractured slowly, a silky, fibrous appearance; when fractured suddenly, the appearance is invariably granular."—*Ibid.*

"Steel, which previously broke with a silky, fibrous appearance, is changed into granular by being hardened."—*Page* 93.

"Steel is reduced in strength by being hardened in water, while the strength is vastly increased by being hardened in oil."—*Ibid.*

"The higher steel is heated (without, of course, running the risk of being burned,) the greater is the increase of strength by being plunged into oil."—*Ibid.*

"In a highly converted, or hard steel, the increase in strength and in hardness is greater than in a less converted or soft steel."—*Ibid.*

"Heated steel, by being plunged into oil instead of water, is not only considerably *hardened* but *toughened* by the treatment."—*Ibid.*

"Steel plates, hardened in oil and joined together with rivets, are fully equal in strength to an unjointed soft plate; or the loss of strength by rivetting is more than counterbalanced by the increase in strength by hardening in oil."—*Ibid.*

"Iron, like steel, is softened, and the breaking strain reduced, by being heated, and allowed to cool slowly."—*Page* 94.

"The welding of steel bars, owing to their being so easily burned by slightly overheating, is a difficult and uncertain operation."—*Page* 95.

"The most highly converted steel does not, as some may suppose, possess the greatest density."—*Ibid.*

"In cast steel the density is much greater than in puddled steel, which is even less than in some of the superior descriptions of wrought iron."—*Ibid.*

On pages 164 and 165, will be found tabulated results of the effects of the treatment of cast steel bars, heated and cooled in oil and water, which show that a bar of JOWITT'S cast steel, for chisels, was first highly heated, and cooled in oil; this, before breaking, stood a strain equal to 215,400 lbs. to the square inch—whilst another part of the same bar, highly heated, and cooled in water, only stood 90,049 lbs. to the square inch. The whole of the experiments gave similar results.

"Thus, in the hardening of steel, by hardening in water, in the ordinary way, the strength was found to be reduced twenty-six per cent., whereas, by hardening in oil, the strength was increased seventy-nine per cent."—*Page* 213.

Remarks on and Results of Experiments made on Steel, [*by* STYFLE, *the great Swedish Metallurgist.*

At the present time, when "Steel *versus* Iron," and the adaptability of steel to cold climates, are the great engineering questions of the day, the experiments made by STYFLE, the great Swedish Metallurgist, and others, are of great interest. In considering whether steel should be substituted for iron, certain objections have long been brought forward, especially in those countries which suffer from a severe climate, such, for instance, as Russia, Canada, &c. On this point STYFLE has, by his elaborate experiments, arrived at certain remarkable results, which run directly counter to the general belief; results which show, indeed, that iron and steel are, if anything, actually stronger when exposed to severe cold, than at ordinary temperatures. This was proved to be the case in the experiments as to extensibility, strength, and resistance to flexure. It is not to be denied, however, that both iron and steel, employed as railway material, and exposed to sudden concussion, breaks more frequently in cold than in ordinary climates, from the fact that, amongst other things, the supports and ground are frozen. Nevertheless, it may be seen, from STYFLE'S numerous tests and experiments, that, for the most important articles, steel is recommended in preference to iron; and for countries like Canada, &c., that suffer from severity of climate, he recommends a mild steel, not only for railway materials, but also for ship plates, bridges, girders, boilers—and, indeed, for nearly all the principal articles of ordinary iron manufactures.

SIR W. FAIRBAIRN, *on the same subject, says:*—

"In all northern countries, where the winters are severe, double thickness in the wood sleepers would offer increased security to the rails, and remove the jar or vibrating motion from the rails and the rolling load.

"I may mention that all rigid supports are objectionable, for the support of railway bars, and that a compressible and elastic substance, such as wood bedded on earth, is infinitely superior to stone blocks; as the timber and porous earth act as a cushion to the rolling load. Many hundred of miles laid with stone blocks had to be replaced with wood sleepers at the commencement of railways."